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An Analysis of the Level of Provision of Outpatient Healthcare Services by a Healthcare Provider: Telemedicine, Demographic Transitions and Health Economics

Abstract in English

Introduction: In recent years, the Polish primary health care system has undergone profound structural transformation driven by the COVID-19 pandemic, the accelerated implementation of telemedicine, progressive population ageing, and increasing economic pressure. These concurrent processes have substantially affected the organization of service delivery, the structure of health care demand, and the financial stability of health care providers. The aim of this doctoral dissertation was to conduct a multidimensional analysis of the level of provision of ambulatory services within a public health care entity, integrating three complementary perspectives: telemedical transformation, demographic and clinical determinants of patient utilization patterns, and economic factors shaping provider performance.

Material and Methods: Retrospective analyses were performed using anonymized medical records and aggregated financial data obtained from a network of primary health care clinics operating in a mixed urban and rural setting. The clinical and organizational analysis covered the period from January 2020 to December 2024, while the economic analysis encompassed January 2021 to June 2025. Telemedicine component. The telemedicine analysis included 720,133 consultations provided to 54,430 patients. Explanatory variables comprised age, sex, type of consultation (in person versus teleconsultation), pandemic phase (pre COVID-19, lockdown, first wave, second wave, epidemic emergency state, post-COVID-19 period), and clinical actions undertaken during the visit (prescription issuance, specialist referral, diagnostic test ordering). Differences in the distribution of categorical variables across pandemic periods were assessed using Pearson chi square tests. The strength of associations was evaluated based on χ^2 statistics and corresponding p values. Comparative analyses enabled identification of structural shifts in service delivery models across successive phases of the pandemic. Demographic and clinical components. This analysis included 42,844 patients aged 60 years or older and 738,300 consultations. For continuous variables, means, standard deviations, and ranges were calculated. Associations between categorical variables, such as chronic disease status versus absence of chronic disease, first visit versus follow up visit, and type of service provided, were examined using chi square tests. For variables not meeting normality

assumptions, nonparametric comparisons were applied. The relationship between age and number of visits was assessed using Spearman rank correlation. To identify predictors of reutilization within predefined time horizons of 30, 60, and 90 days, logistic regression models were constructed. Odds ratios with corresponding levels of statistical significance were calculated to estimate the relative contribution of variables such as prior visit frequency, psychiatric referrals, and pandemic period to the probability of return visits. Economic component. Time trend analyses were conducted using descriptive statistics. Dynamics of total revenue, National Health Fund financing, total costs, and personnel expenditures were evaluated. Year over year percentage changes were calculated, as well as the proportion of personnel costs within total costs and the monthly cost to revenue ratio. Differences in cost growth between permanently employed staff and contracted personnel were analyzed separately. Operational profitability was assessed through margin analysis and the proportion of months with full cost coverage by revenue. Across all analyses, a significance threshold of $p < 0.05$ was adopted. Interpretation of findings considered not only statistical significance but also effect sizes and their potential clinical and systemic relevance.

Results: The COVID-19 pandemic substantially altered the structure of service provision. During the lockdown period, teleconsultations accounted for 78.5% of all consultations. Subsequently, their share declined and stabilized at approximately 12 to 15% in the post pandemic period. Statistically significant differences were observed between consecutive pandemic phases. Teleconsultations were more frequently associated with prescription issuance, whereas in person visits more often resulted in diagnostic test orders and specialist referrals. Younger patients utilized teleconsultations more frequently than individuals aged 60 years or older, who consistently preferred direct contact. Within the older population, the mean annual number of visits was 10.3, and age demonstrated a positive correlation with total consultation frequency. Prescriptions were issued in 56.9% of visits, referrals in 33.5%, and diagnostic tests in 21.4%. Patients with chronic diseases more frequently received diagnostic orders but were less likely to return within short time intervals. The pandemic temporarily reduced service utilization, whereas the post-COVID-19 period was associated with a significant increase in health care use. Although demographic and clinical factors demonstrated statistically significant associations with service patterns, the magnitude of observed effects was moderate. The economic analysis revealed a progressive financial imbalance. Between 2021 and 2025, total revenue increased by 46% and National Health Fund financing by 50%, while total costs rose by 85%. The share of personnel expenditures increased from 80% to over

86% of total costs, with particularly dynamic growth observed among contracted staff. From late 2022 onward, costs consistently exceeded revenue, and full cost coverage was achieved in only 20% of analyzed months.

Conclusions: The level of ambulatory service provision within the analyzed entity was simultaneously shaped by epidemiological, demographic, and economic determinants. Telemedicine, although stabilized at a moderate level following the pandemic, has become an enduring component of the service delivery model. Population ageing generates high service utilization intensity, while inter subgroup differences in clinical outcomes remain relatively limited. The most substantial threat to continuity of ambulatory care provision arises from escalating cost pressure, primarily driven by rapid growth in personnel expenditures and insufficient tariff adjustments. The findings indicate that maintaining stability and accessibility of ambulatory care requires coordinated action encompassing expansion of digital infrastructure, adaptation of care models to the needs of the geriatric population, and systemic reform of financing mechanisms. Integration of these three dimensions constitutes a critical prerequisite for sustaining efficiency and operational security of ambulatory health care providers in a dynamically evolving system environment.